California Stationary Fuel Cell Collaborative
Position in Support of the Hydrogen Highway Initiative

The California Stationary Fuel Cell Collaborative ("Collaborative") supports the Executive Order (EO) signed by Governor Schwarzenegger to achieve a clean energy and transportation future based on the rapid commercialization of hydrogen and fuel cell technologies.

The Collaborative has taken a leadership role in facilitating the advancement, demonstration, and use of fuel cells for power generation in stationary applications throughout California. Members of the Collaborative represent organizations interested in combining efforts and resources towards commercialization of stationary fuel cells (SFCs) in California. Several California agencies such as the Air Resources Board, the California Energy Commission, the Department of General Services, the National Fuel Cell Research Center, and the South Coast Air Quality Management District form a Core Group of the Collaborative. The Core Group also includes non-government organizations and public utilities. In addition, members of the Collaborative include fuel cell manufacturers, fuel suppliers, research institutions, vehicle manufacturers, energy companies and other associated industries.

The Governor's EO specifically directs the Collaborative to support the development and implementation of the Hydrogen Highway plan for California. The Collaborative can provide valuable insight based on the experience of its members and on its accomplishments as an organization. For example, the Collaborative conducts an annual survey of stationary fuel cell manufacturers that summarizes the input received regarding: recent activity and future ability to manufacture, sell and install fuel cells; product characteristics and costs (including warranty and service contract options); customer / market targets; and barriers to commercialization in California. In addition, the Collaborative has sponsored recent studies to evaluate the economics of fuel cells compared to other distributed generation technologies and "A Review of Approaches to Advanced Power Technology Programs in the United States and Abroad -- Including Linked Mobile and Stationary Sector Developments."

The Collaborative envisions stationary fuel cells serving critical, and economically viable, roles in support of hydrogen refueling infrastructure. Stationary fuel cells are already deployed in operating hydrogen-refueling stations, and their use throughout the hydrogen highway network can contribute to overall hydrogen highway success in several ways. Namely, stationary fuel cells can:

- Increase the efficiency and utility of the refueling process.
- Increase hydrogen utilization in stations that may otherwise be underutilized.
- Advance hydrogen-refueling technology.

Two applications are immediately appropriate for SFCs in support of the hydrogen-refueling infrastructure. First, SFCs will be used to co-produce power and heating/cooling at the refueling site. This can be accomplished through an independent energy station, an institutional facility (e.g., fleet refueling), or a commercial business building (e.g., convenient refueling for building occupants). While SFCs are conventionally fueled by natural gas, the natural gas is reformed within the system to produce hydrogen, which is consumed by the SFC to produce electricity and heat. The availability of hydrogen at a hydrogen-refueling site provides fuel that a SFC can consume directly. This provides not only a source of local electric and thermal power that is valuable, but supports the overall balance of plant and balance of operations and control of the refueling station. Without the SFC, the hydrogen production or storage on-site would be required to waste hydrogen (through venting or flaring), operate less efficiently, or shut down and restart regularly (leading to increased waste and lower efficiency) to match hydrogen-refueling demands. The analogy is a hydroelectric dam, which, in addition to producing electricity, is storing water for domestic use and serving to control flooding. In the case of hydrogen refueling, the SFC serves to utilize the hydrogen stored onsite for the generation of electrical and thermal power when automobile refueling needs are low and/or hydrogen storage is reaching full capacity, conferring to the facility ample flexibility to meet both power thermal needs (which may include an on-site fuel processor) at overall efficiencies that approach 90 percent.

The second immediate application of SFCs to the hydrogen highway is their use to generate hydrogen on-site in order to meet the refueling requirements in parallel with the generation of electricity. This strategy utilizes the emerging high temperature stationary fuel cells (HTFCs) such as molten carbonate fuel cells and solid oxide fuel cells. HTFCs possess four major characteristics that make them remarkably attractive for playing a synergistic role in the hydrogen-refueling plan for California led by Governor Arnold Schwarzenegger:

1. High fuel-to-electricity conversion efficiencies up to 50 percent (using natural gas or biogases such as landfill and digester gas),
2. High-quality waste heat sufficient for heating, industrial processing and thermally activated cooling applications,
3. Co-production of power and hydrogen with minor modifications of the current power-only products; and
4. Ultra low criteria pollutant emissions.

As with all fuel cells, HTFC systems do not use all the fuel that is supplied. The unconsumed fuel is traditionally oxidized at the exit of the stack and used in other parts of the system before being exhausted as high-quality waste heat. With modifications to the current HTFC power-only products, this unused fuel can be separated and used for cost-effective co-generation of hydrogen. This application is viewed as potentially the most efficient, cost-effective, and environmentally sensitive means of generation of hydrogen from natural gas. This claim is bolstered by several technical facts: (1) heat required by a natural gas reformer is synergistically provided exactly where it is needed by the heat release of the SFC electrochemical reactions, (2) fuel cell efficiency increases since the SFC is not required to consume as much hydrogen in a single pass through the fuel cell stack, (3) local production of hydrogen at the refueling station avoids all costs and emissions associated with hydrogen transport (which are very significant), and (4) dynamic selection of relative hydrogen and electricity production levels provides the user with flexibility to maximize cost effectiveness over the entire and widely varying duty cycles associated with both refueling and electricity value. At central plant scale, thermodynamic analyses of HTFC configurations reveal that the co-generation of hydrogen and electric power will be the environmentally responsible strategy of choice in future natural gas and coal-fired applications.

In summary, stationary fuel cells are emerging today into the commercial natural gas market around the world. Both residential-sized units at 5 kilowatts, and commercial building and industrial units ranging from 200 kilowatts to multiple megawatts are being widely deployed. The pricing in the early market is understandably higher than conventional technologies, but incentive and buy-down programs are providing economically viable solutions today. In addition, the projections established by Collaborative surveys point to improved manufacturing and mass production that will bring down the base price of stationary products to competitive levels within a few years. The recovery and utilization of waste heat provided by the distributed generation paradigm is a key to a competitive economic strategy. Studies conducted by the Collaborative show that energy operating costs can be reduced by more than a factor of 2 through use of co-generating fuel cells (based on typical electric and natural gas utility rates in force today). The associated payback period can be attractive to both private and public investment.

The Hydrogen Highway Plan for California can and will benefit by the use of SFC technology and installations that use natural gas. In addition, SFCs that directly use hydrogen can provide electricity and co-generation benefits to a broader cross-section of California citizens using hydrogen that would have otherwise been wasted. SFC technology will be advanced through these deployments and the track record established by hydrogen highway installations will have a positive impact on the role of the SFC market. The high-efficiency of HTFCs, near-zero emission of criteria pollutants, and high quality of waste heat are directly supportive of both the spirit and mission of the Hydrogen Plan for California. The additional abilities of SFCs to (1) efficiently co-generate hydrogen in a remarkably environmentally responsible manner, and (2) stabilize the operations and controls of a hydrogen refueling plant are also directly applicable and needed for success of the Hydrogen Plan for California.